



Calhoun: The NPS Institutional Archive
DSpace Repository

Theses and Dissertations

1. Thesis and Dissertation Collection, all items

1965

An analysis of population problems as they
affect economic growth in selected Latin
American countries

Griffin, Gerald B.

Monterey, California. Naval Postgraduate School

<http://hdl.handle.net/10945/36971>

Downloaded from NPS Archive: Calhoun



Calhoun is the Naval Postgraduate School's public access digital repository for research materials and institutional publications created by the NPS community. Calhoun is named for Professor of Mathematics Guy K. Calhoun, NPS's first appointed -- and published -- scholarly author.

Dudley Knox Library / Naval Postgraduate School
411 Dyer Road / 1 University Circle
Monterey, California USA 93943

<http://www.nps.edu/library>

UNCLASSIFIED

AD NUMBER
AD475356
NEW LIMITATION CHANGE
TO Approved for public release, distribution unlimited
FROM Distribution: Further dissemination only as directed by Naval Postgraduate School, Monterrey, CA, 1965 or higher DoD authority.
AUTHORITY
USNPS ltr, 21 Jan 1972

THIS PAGE IS UNCLASSIFIED

AD 475356

2

UNITED STATES
NAVAL POSTGRADUATE SCHOOL



RESEARCH

AN ANALYSIS OF POPULATION PROBLEMS
AS THEY AFFECT ECONOMIC GROWTH IN
SELECTED LATIN AMERICAN COUNTRIES

* * * * *

Gerald B. Griffin

This document may be further distributed by any holder only with specific prior approval of the U. S. Naval Postgraduate School (Code 035).

AN ANALYSIS OF POPULATION PROBLEMS
AS THEY AFFECT ECONOMIC GROWTH IN
SELECTED LATIN AMERICAN COUNTRIES

* * * * *

Gerald B. Griffin

AN ANALYSIS OF POPULATION PROBLEMS
AS THEY AFFECT ECONOMIC GROWTH IN
SELECTED LATIN AMERICAN COUNTRIES

by

Gerald B. Griffin

Leiutenant, United States Navy

Submitted in parital fulfillment of
the requirements for the degree of

MASTER OF SCIENCE
IN
MANAGEMENT

United States Naval Postgraduate School
Monterey, California

1 9 6 5

AN ANALYSIS OF POPULATION PROBLEMS
AS THEY AFFECT ECONOMIC GROWTH IN
SELECTED LATIN AMERICAN COUNTRIES

by

Gerald B. Griffin

This work is accepted as fulfilling
the research paper requirements for the degree of

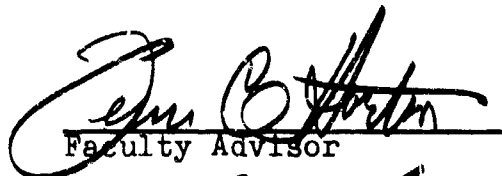
MASTER OF SCIENCE


IN

MANAGEMENT

from the

United States Naval Postgraduate School


Faculty Advisor


Chairman
Department of Business
Administration and Economics

Approved:


Dean of Programs

ABSTRACT

In an era of unprecedented population expansion, economically underdeveloped countries have the seemingly insuperable task of raising their standard of living while trying to stay abreast of astonishing increases in population. Simply stated, the problem of economic development in these countries is to increase production at a rate in excess of man's reproduction.

This study was made to learn in what manner the demographic variables of total population size, rate of population growth, and composition of the population influence economic variables, particularly in Latin American areas, where population growth in certain countries is the highest of the major cultural regions of the world.

TABLE OF CONTENTS

CHAPTER		PAGE
I.	THE PROBLEM AND DEFINITIONS OF TERMS USED .	1
	The problem	1
	Theoretical background	3
	Definitions of terms used	5
	Demography	5
	Gross national product	5
	National income	5
	Population	6
	Underdeveloped country	6
II.	REVIEW OF THE LITERATURE	7
	Standards of selection	7
	The sources searched	7
	General statement	8
	Total population	9
	Rate of population growth	15
	Composition of population	18
	Economic growth	20
III.	ANALYSIS	28
	Basis of selection of countries	28
	Relationships between economic and demographic variables	30
IV.	RESULTS AND CONCLUSIONS	33
	Total population	33

CHAPTER	PAGE
Rate of population growth	35
Composition of population	42
Levins developmental model	44
Summary of conclusions	46
BIBLIOGRAPHY	48
APPENDIX A	50

LIST OF TABLES

TABLE	PAGE
I. Selected Characteristics of Countries Studied	29
II. Correlations Between Demographic and Economic Data	34
III. Agricultural Land Used or Potentially Productive	36
IV. Effect of Lower Population Growth Rates on Per Capita Gross National Product in Chile	37
V. Effects of Lower Population Growth Rates on Per Capita Gross National Product in Ecuador	38
VI. Effects of Lower Population Growth Rates on Per Capita Gross National Product in Honduras	39
VII. Effects of Lower Population Growth Rates on Per Capita Gross National Product in Paraguay	40
VIII. Non-productive Population Ratios	43
IX. Percentage of Total Economically Active Population Engaged In Non- agricultural Activity in Chile	45

TABLE

PAGE

X.	Percentage of Total Economically Active Population Engaged in Non- Agricultural Activity in Honduras	45
XI.	Selected Data For Chile	53
XII.	Selected Data For Ecuador	54
XIII.	Selected Data For Honduras	55
XIV.	Selected Data For Paraguay	56

LIST OF FIGURES

FIGURE		PAGE
1.	Relationship of Income to Population . . .	10
2.	Marginal Product of Labor	23
3.	Economic Growth in the Bi-sector Model . .	25
4.	Plot of Population and GNP for Honduras . .	51
5.	Plot of Population and Consumption for Honduras	52

CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

I. THE PROBLEM

Since primitive times man has been able to increase his production of food and other necessities sufficiently to allow an enormous expansion of his numbers. At times, production has increased much faster than populations have grown; in fact, the advance of civilization has depended upon man's ability to expand production so that an excess was created beyond that minimum necessary for the maintenance of a growing population. However, it has been only in certain parts of the earth and during certain periods of time that production has kept ahead of man's reproduction and the level of living for people has been raised.¹

This problem has become especially acute during recent decades. Modern preventive medicines have reduced the death rates of many parts of the world while high rates of birth have continued. Economically underdeveloped countries have the seemingly insuperable economic task of raising their standard of living while trying to stay abreast the astounding increases in population. Simply stated, the problem of economic development in these coun-

¹United Nations, The Determinants and Consequences of Population Trends: Population Studies, No. 17 (New York: United Nations, 1963), p. 181.

tries is to increase production at a rate in excess of the rate of population growth.

Observers are often impressed with the fact that certain countries in Latin America have the highest rates of population increases of the major cultural areas of the world.² At the same time, these countries are faced with the fact that most of their peoples live in conditions of abject poverty.

This study, using conventional economic concepts, will seek to discover, first, if any meaningful correlation between recent series of demographic statistics and recent series of economic statistics can be established for selected countries in Latin America. Secondly, influences of population variables on economic variables in general will be investigated. Thirdly, using a bi-sectoral economic development or growth model constructed by W. A. Lewis, an attempt will be made to predict if these countries will reach a state of economic development where they are self-sustaining and from which rapid

²"Facts and Figures," Americas, XVI (July, 1964), p. 46. The rate of natural increase in many countries in Latin America is nearly thirty per thousand, a rate which if maintained would double the population in less than thirty years.

progress is possible.³

The demographic variables to be investigated are:

(1) total population; (2) rate of population growth; and (3) composition of the population. These variables are those often cited as exerting the most influence on economic variables.⁴

Theoretical background: Population theory crosses the lines of many disciplines including geography, sociology, anthropology, economic, ecology, even genetics and medicine which have investigated methods of birth control and developed many preventive medicines.

Economists are concerned with population factors as they affect the ability of the economic system of a country to satisfy human wants. The number of people to be supplied directly conditions the success of an economic system to produce the goods and services necessary. One of the essential factors of production is labor which is directly influenced by population factors. Not only are the numbers of the labor force important, but also their

³See page 29, for a more detailed explanation.

⁴A. J. Coale and E. M. Hoover, Population Growth and Economic Development in Low-Income Countries (Princeton New Jersey: Princeton University Press, 1958), p. 18; P. M. Hauser and O. T. Duncan, The Study of Population An Inventory and Appraisal (Chicago: The University of Chicago Press, 1950), p. 804.

age, sex, and the skills they possess; important also is the ratio of other factors of production available for combining with the labor force.

Economist's interest in the role of population grew greatly as a result of the publication of Malthus' Essay On Population at the end of the eighteenth century.⁵ This essay aroused a storm of controversy that still continues, and made the need for adequate empirical information apparent, if theories were to be tested.

During much of the eighteenth century, economists paid relatively little attention to population phenomena, treating it as only one of many inter-dependent variables which interact within the matrix of variables that comprise an economy.

More recently, economists have renewed their interest in population as a factor important in economic development, particularly in less advance cultures.

Empirical studies of the effect of population variables on economic variables have not been wide-spread, at least in underdeveloped countries for two reasons. First, reliable economic and demographic data from underdeveloped nation has been generally hard to come by. Secondly, population variables are only one of the many at work within

⁵T. H. Malthus, Essay On Population, ed. Gertrude Himmelfarb (New York: The Modern Library, 1960).

an economy and knowledge of the effects of changes is not well known.

II. DEFINITION OF TERMS USED

Demography. There is no single standard of what demography is even among demographic experts; the definition varies from time to time and place to place. For purposes of this paper, the following definition is given: Demography is the science which deals with the statistics of human population such as size, density, growth, distribution, the changes therein, and the components of such changes.

Gross national product. A term used by the United Nations when speaking of national accounting aggregates which is defined as:

. . . value of the product before deduction of provisions for consumption of fixed capital, attributable to the factors of production supplied by normal residents of the given country. It is identically equal to the sum of consumption expenditures and gross domestic capital formation, private and public, and the net export of goods and services plus the net factor incomes received from abroad.⁶

National income. As defined by the United Nations,

⁶United Nations, Yearbook of National Account Statistics 1963 (New York: United Nations, 1964), p. xi.

"National income is the sum of incomes accruing to factors of production supplied by normal residents of a given country before deduction of direct taxes."⁷

Population. Population as a concept refers to the actual aggregations of humans, and is a far wider concept than demography. Population studies are concerned not only with population variables, but also with the relationships between population changes and other variables -- social, political, economic, biological, genetic and so on.

Underdeveloped country. This term is used by the United Nations to replace "backward country", or one whose economy is not well advanced, who lacks sufficient industrialization, market structure and economic institutions to provide an adequate standard of living for its people.

⁷Ibid.

CHAPTER II

REVIEW OF THE LITERATURE

Standards of selection. Because population theory touches or overlaps many disciplines, any effort to review completely all literature bearing on population problems would be a staggering task. In order to reduce the task to manageable proportions, review was limited largely to the literature of demography and that area of economics concerned with problems caused by population growth. The portion of economics which is concerned with economic problems in underdeveloped countries and particularly the problems of economic growth in these countries received stress.

One further standard of selection was necessary in order to limit the literature reviewed to acceptable amounts. With one or two exceptions made necessary by their extreme importance to the subject, only that written within the last twenty years was included.

The sources searched. The sources were limited to those found in the library at the United States Naval Postgraduate School, Monterey, California. Information from various United Nations publications and the American Economic Review were particularly useful.

General statement. The points of convergence between economics and demography may be indicated in terms of demographic variables, changes in which may affect economic variables. It is ~~stated~~ (1) that the two sets of variables may be complexly interrelated; (2) that the relation between economic and demographic variables may be ~~affected~~ by the presence or absence of other non-identified variables; (3) that short-run effects of demographic or economic change may differ from long-run effects; and (4) while it may not be difficult to determine the direction of economic effect accompanying some change in population, it frequently is not easy to determine the magnitude of such an effect.¹ These problems are listed to indicate that study of relationships between these two subjects is not an easy task. One further difficulty which should be mentioned is that empirical information concerning the impact of demographic change upon economic change is not plentiful. There is, of course, considerable information on wage and income movements and structures, levels of employment, variation in savings and investment, but this data does not readily permit analysis of population effects on economic change. Ac-

¹Douglas S. Paauw, "Some Frontiers of Empirical Research in Economic Development," Economic Development and Cultural Change, IX (January, 1961), pp. 180-190.

quiring either economic or demographic data for use in the study of many underdeveloped countries is especially difficult because facilities generally do not exist (or have existed for a short time only) for collection of such information.

While theoretically many demographic variables are viewed as exerting an influence on economic variables, empirical studies in specific areas of the world have been forced to greatly simplify the number of variables both demographic and economic that can be used.²

The three demographic variables generally studied are total population, rate of population growth, and composition of population.³

Total population. Many economists and demographers subscribe to the theory of optimum population which holds that for a given country and under given conditions, a certain size total population enables the greatest per capita income possible to be realized. The relationship that is said to exist between total population and per capita income can be shown graphically as in Figure 1.

²Ibid.

³A. J. Coale and E. M. Hoover, Population Growth and Economic Development in Low-Income Countries (Princeton, New Jersey; Princeton University Press, 1958), 18.

The horizontal axis measures population (P), while the vertical relates to average income (Y). The curve YP depicts the dependence of the economic variable, income, on the demographic variable, population. Point P_1 , at which per capita income is maximum represents the optimum population. Population beyond P_1 indicates over-crowded conditions; at values smaller than P_1 , the economy is said to be under-populated.

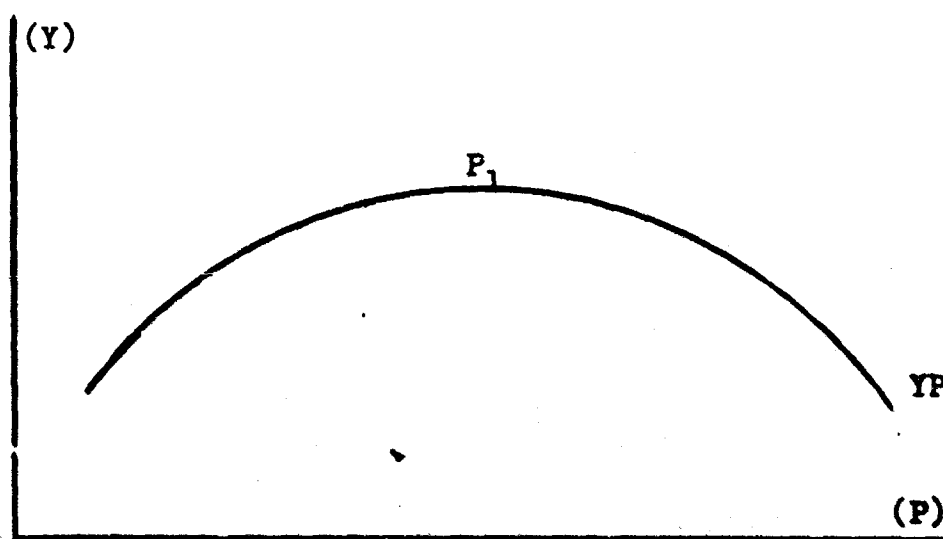


FIGURE 1
RELATIONSHIP OF INCOME TO POPULATION

Population size is thought to influence economic variables through the returns to scale principle.⁵ Speaking on economies of scale, United Nations writers have said,

The improvements in economic organization to which an increase in the size or density of population may lead are of two types: (a) extension of the division of labour, and (b) adoption of more efficient scales of production. Each of these influences result in economies of production, and hence increases output per unit of cost.⁶

A few paragraphs later is stated,

The size and density of population necessary to permit maximum economies of scale must be considered not only with regard to what is needed to provide a sufficiently large market for a single firm or other economic unit, but also with regard to the number of units engaged in each type of economic activity and their interrelations with one another.⁷

To the left of point P_1 on the YP curve in Figure 2, economies of scale serve to increase per capita income as population increases. To the right of this point diseconomies of scale come into operation.

⁵Many writers in discussing the effects of total population on the economy speak not only of the economies of scale, but also of diminishing returns at the same time. Since by definition both do not occur together, it is assumed that diseconomies of scale are meant rather than diminishing returns.

⁶United Nations, The Determinants and Consequences of Population Trends, p. 229.

⁷Ibid., p. 230.

Quoting from United Nations writers again,

The productivity of human labour depends, other conditions being given, upon the amount of resources in use at its disposal. More specifically, physical output per worker per time period in any employment is governed mainly by the amount of resources and equipment used. Consequently, if all things remained equal, the growth of population and the labour force would tend to reduce per capita output by reducing the amount of resources and equipment per worker involved in production. This principle is the main foundation of the thesis which has been expressed since the days of Malthus and even earlier, that population growth tends to reduce the level of living or else check its rise. Its simplest illustration is in the so called "law of diminishing returns" as applied to agricultural labour and land. Given a certain amount of land which can be cultivated and assuming the methods and equipment to be constant, an increase in the number of units of labour employed beyond a certain point brings reduction in the product per unit labour.⁸

Spengler writing on the relationships between population and economics said essentially the same,

Within limits, increase in T [total population] may operate to increase y [per capita income] (given as constants all conditions except those affected by increases in T) and thereafter serve to reduce y . For up to a point increases in T give rise to improvements in organization and other sources of increasing return, and these improvements more than offset such adverse effects as eventually accompany decreases in the amount of land and other resources available per head. Eventually, the decline in 1 [land and other resources per capita] constitutes a drag on the upward movement of y further increases in T operate to make y lower than it otherwise would have been, and this tendency is accentuated when population growth serves to slow down the

⁸ Ibid., p. 224.

rate at which capital per head is formed⁹

Critics of this theory have indicated that the optimum population concept, while providing a convenient framework for theorizing, is subject to so many limitations and uncertainties as to be of limited use as an analytic tool. The question of whether a given population is smaller or larger than one yielding maximum per capita income is very difficult to answer in any given situation. The difficulty lies in trying to quantify various indices of over-population or under-population. Examples of indices that have been suggested include: (1) migration; (2) the pattern of consumption; (3) the amount of unemployment; (4) the length of life; (5) the presence or absence of "diminishing returns"; (6) the terms of international trade; (7) the density of population measured in various ways.¹⁰

While it is true that many countries do not possess adequate land or other natural resources, in general, the factor of production most often leading to eco-

⁹J. J. Spengler, The Study of Population An Inventory and Appraisal, ed. P. M. Hauser and O. D. Duncan (Chicago: The University of Chicago Press, 1959), p. 805.

¹⁰United Nations, The Determinants and Consequences of Population Trends, p. 235.

economic growth problems in Latin America is not land, but limited quantities of capital available relative to the size of the labor force.

Increases in total population may affect the distribution of income. If, in fact, growing population does slow down the rate at which capital per head can be formed and reduces the value of resources available per capita, and labor become more plentiful, compared with other factors, then the rate at which the human agent is productive and remunerated compared with the rate at which capital and land are productive and remunerated, becomes lower. This, of course, will depend on the elasticity of the substitution of labor. Elasticity, in turn, will depend on the technical conditions of productivity, and the substitutability of labor for other factors. The assumption is generally made, however, that labor will comparatively receive less compensation.

Increases in total population may affect the level of employment in a given country if the proportions with which capital and labor can be combined are not sufficiently variable. This condition is likely to occur in underdeveloped countries where technological change and redistribution of workers among employments does not occur

rapidly enough to permit all increases in the labor force to be combined properly, if at all, with other productive factors.¹¹

It is possible that increase in total population will cause an increase in consumption at the expense of saving, if per capita income falls. The ratio of savings to national income would therefore decline. Composition of consumption could also be expected to change in this case as shifts were made to cheaper commodities and inferior goods.

Rate of population growth. The second factor that must be considered in analyzing the effects of population variables on economic variables is rate of population growth.

The most significant feature of population growth rate is that high rates of growth require higher levels of needed investment if per capita income is to be maintained, yet there is nothing about faster growth that generates a greater supply of investible resources.

All underdeveloped countries lack an adequate supply

¹¹Masao Fukuoka, "Full Employment and Constant Coefficients of Production," Quarterly Journal of Economics, LXIX, pp. 23-44.

of equipment and other means of productivity which are of good quality. This fact coupled with the generally low productivity of labor and low per capita income makes it extremely difficult to form capital at a sufficient rate. Quoting United Nations experts, "It is as if the hoe were asked to produce enough to feed its owner and also leave a surplus for purchase of a tractor".¹²

Furthermore, a distinction has been made between "demographic" investments, which are necessary to support the growing population, and "economic" investments which raise the standard of living. It is obvious that the size of the demographic investment depends directly on the rate of population increase. In underdeveloped nations, it is feared by experts that demographic investments may use up all available capital, thus retarding economic development indefinitely.¹³ To provide the capital for a two and one-half percent annual population increase, United Nations experts have estimated that up to twelve and one-half percent of national income is required for demographic investment if per capita income

¹²United Nation, The Determinants and Consequences of Population Trends, p. 278.

¹³United Nations, Measures For Economic Development In Underdeveloped Countries (New York: United Nations, 1951), p. 47.

is to be maintained, with no rise in standard of living.¹⁴

Because the typical age structure in underdeveloped countries generally places a heavy burden of dependency on each family, the possibilities of saving are further reduced as the entire income is absorbed.

Efforts are often made to secure foreign capital, but some economists have rejected the idea that foreign loans can compensate fully for major deficiencies in domestic rate of saving for these reasons: (1) a nation can obtain large amounts of capital only if its internal economic conditions are favorably inclined, and such is not likely to be the case when low per capita income is creating social disorganization and political instability. (2) because a complementary relationship exists between different kinds of capital at different stages in a country's development, a nation's internal rate of capital formation determines, in part, the amount of capital from abroad which can economically be absorbed at any one time, even when easy credit terms are to be had; (3) the underdeveloped nation must repay the loan within a reasonable time, out of savings, if it is to avoid excess debt and maintain a good credit rating.¹⁵

¹⁴Ibid.

¹⁵B. Okun and R. W. Richardson, Studies in Economic Development (New York: Holt, Rinehart and Winston, 1961), p. 258.

Many authorities, therefore, consider the rate of population growth to be the demographic variable most responsible for limiting economic growth in underdeveloped countries.¹⁶

Composition of population. The third factor which enters into an analysis of the effect of population change on economic variables is composition of the population by age, sex, and qualitatively.

One of the chief obstacles to economic development is the manpower shortage which exists even in the so-called over-populated countries. The reduction of mortality, particularly among children, coupled with a persistently high birth rate causes the ratio of persons who are in a dependent status because of their age (either too young, or too old to work) to persons eligible for productive work to be relatively high. In short, economies with high birth rates must "waste" more of their productive substance on non-productive persons than would be required if a lower birth rate existed.

Changes in age composition, other factors being given, are usually associated with changes in per capita

¹⁶J. J. Spengler, "The Population Obstacle to Human Betterment," American Economic Review, XLI No. 2 (May, 1951), p. 352; S. Enke, Economics For Development (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1963), p. 370.

income, per capita capital, and savings, each of which tends to vary positively with the ratio of the labor force to population.¹⁷

Qualitative factors of the productive members of a population also bear on output. Worker's health, for example, affects directly the number of workers as well as the capabilities of workers. Poor health is emphasized as a major cause of low productivity of a labor force, particularly in underdeveloped countries.¹⁸

Lack of vocational skills and aptitudes contributes to low productivity. This becomes most apparent as workers move from rural, agricultural vocations to jobs employing new equipments and methods. In the long run, the development of a well qualified labor force requires a certain minimum of fundamental education for the mass population as well as institutions for higher learning and for research.

Population composition by sex is important in the short run as the numbers of productive members of a population are influenced. Female members generally are considered to be not as economically productive as male members. However, since major divergences from the nor-

¹⁷R. Dorfman, "Economic Indicators of Population," American Economic Review, XLIV, no. 34-379.

¹⁸United Nations, The Determinants and Consequences of Population Trends, p. 266.

mal sex composition of a population are transitory, in the long run, sex composition is not economically important.

Biological model. Population theory as it affects economic growth is only one part of the overall theory needed to build a useful economic model. Other factors requiring consideration in constructing a satisfactory growth or development model include the state of the technology, accumulation of capital, dualism of the economy, consumption, foreign trade, and government developmental plans, among others.¹⁹ Of the factors listed, population growth, capital accumulation, and technology are viewed by many economists as being of major importance and hence are intensively studied.

Lack of an adequate supply of capital equipment and other means of production are characteristic of all underdeveloped countries.²⁰ Yet, capital is urgently needed to combine with other productive factors if output per capita is to be increased. Technological aspects are important in that they permit vast increases in output per capita and have been responsible for much of

¹⁹ ibid., pp. 187-188.

²⁰ ibid., p. 168.

man's economic development, particularly in recent centuries.

As the result of renewed interest in economic development theory, economists have attempted for at least a decade and a half to formulate a satisfactory growth model which when applied to underdeveloped economies would permit useful decisions as to needs and subsequent allocations of capital investments.²¹

Although criticized by some, the work of W. Arthur Lewis is said by many economists to hold promise in providing a more satisfactory, more useful model for underdeveloped countries.²²

Lewis argues that the problem of capital accumulation in economically backward countries is further complicated by the existence of two economic sectors.

The subsistence sector which is largely agricultural in nature is one in which output is shared by each family among its members. The "wage" in this sector is sometimes said to be average product and sometimes viewed as output per head. In either case, it is extremely low -- at the subsistence level -- because labor has very little capital investment to assist productivity. Saving, of course, is negligible.

²¹G. Ranis, "The Population Problem," American Economic Review, LIII No. 2 (May, 1963), p. 622.

²²W. A. Lewis, "Development With Unlimited Supplies of Labour," T. Manchester School, 1954.

In the adjoining capitalistic sector, usually industrial in nature although commercial agriculture may be included, there is enough investment from either savings or foreign loans to give each member a minimum investment which helps him achieve a considerably higher output when compared with the output for workers in the subsistence sector. However, labor in the capitalistic sector will not receive the wages equal to their marginal productivity. Instead, all additional output is returned to the capitalist rather than distributed as wages because an "unlimited" competitive supply of labor is available from the subsistence sector to replace the industrial worker, should he demand higher wages.

This can be seen in Figure 2, page 23, where the wage rate is shown on the vertical axis and the supply of labor is depicted on the horizontal axis. The Marginal-Product-of-Labor Curve is the demand curve for all employers. In a market where the supply of labor is fixed, as at L_1 , an employer would pay a wage to all his employees equal to the marginal-product of the last man hired, retaining for himself that quantity of the marginal-product produced in excess of the wage level by all previously hired workers. The return to the employer is depicted as the area beneath the Marginal-Product-of-Labor Curve, but above the wage level (W_1) that he must pay in order to attract workers.

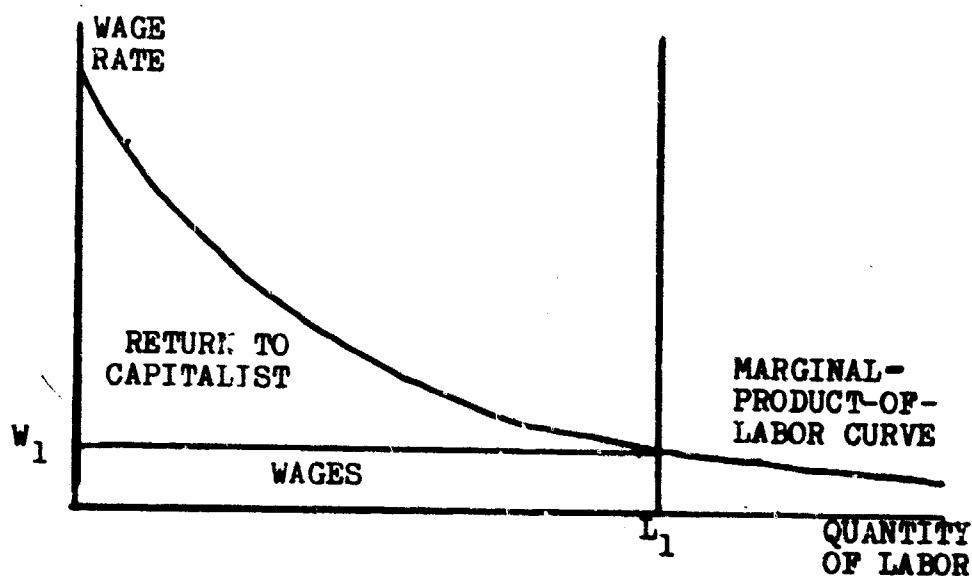


FIGURE 2
MARGINAL-PRODUCT OF LABOR

In the Lewis model, however, the supply of labor is "unlimited", so the employer need only pay a wage high enough above the average "wage" in the subsistence sector to draw workers into the industrial sector, retaining for himself all the productivity of each worker above the wage he must pay. Worker productivity increases in the capitalistic sector because each now has some capital to aid his output. A worker cannot demand wages equal to his marginal-productivity because there is an "inexhaustable" supply of workers waiting to replace him.

The problem seen facing such an economy is that of

smoothly moving surplus agricultural labor to more productive employment in the industrial sector.

The foregoing describes what is called the first phase of a country's development which will continue as long as incomes in the agricultural sector remain at the subsistence level. Capital and technology become important as twin forces which determine the rate of labor reallocation from the subsistence sector to the capitalistic sector. Population growth, on the other hand, continuously adds to the pool of labor that must be absorbed.

Eventually, if an economy can obtain more and more capital, the surplus of labor may be transferred to the industrial sector and the subsistence sector will no longer exist. Graphically, this can be shown as in Figure 3, on page 25, where labor (L) is shown on the horizontal axis and capital (K) on the vertical axis. The first state of economic development as described above is shown as the economy moves from point A to point B. The iso-quants refer to output in the capitalistic sector, while L_1 is the limit of labor available. Factor prices are constant, as are the capital/labor ratios. Wages during this stage are determined for the whole economy by the average product of labor in the subsistence sector, and not by the marginal labor productivity in the capitalistic sector. Eventually, if the economy can obtain more and

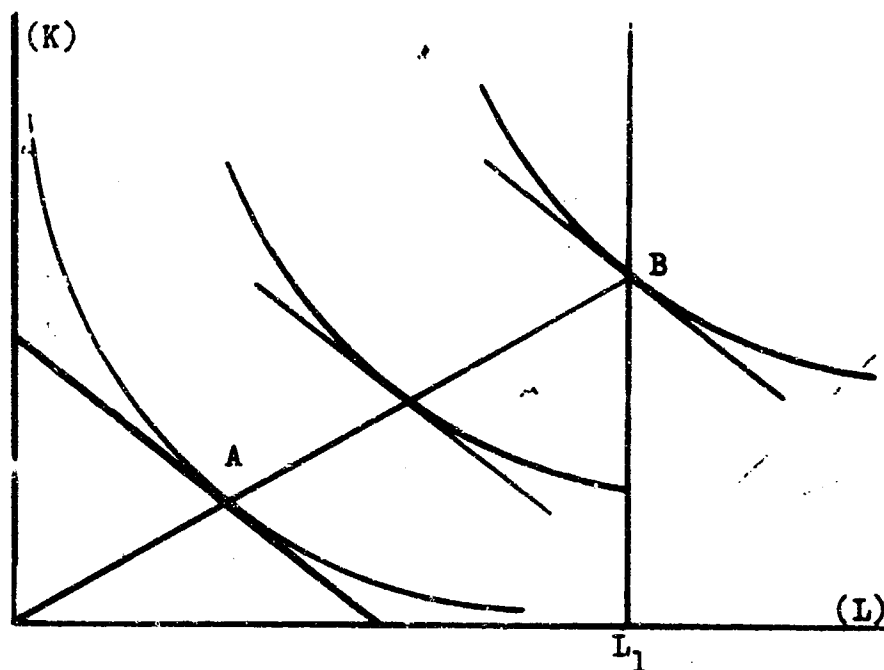


FIGURE 3

ECONOMIC GROWTH IN THE BI-SECTOR MODEL

more capital, it will reach point B. The labor supply then becomes virtually inelastic and wages must be based on the marginal productivity of labor in the capitalistic sector. The economy will then have reached the self-sustaining stage, capable of making rapid economic growth.

In the Lewis model, capital accumulation and the state of technology determine the rate at which labor ~~will be~~ be transferred to the industrial sector. If population growth adds additional labor faster than capital and innovation permit its absorption, economic progress will be

limited.

The problem of acquiring more and more capital in order to move labor from the subsistence sector is complicated in underdeveloped countries by several factors, among which are: (1) entrepreneurs are typically poorly educated in any except local business practices and have neither the knowledge nor the inclination to expand beyond the point where they are capable of hiring more than a handful of workers; (2) while it is true that in all backward countries there are a few extremely wealthy families engaged in major enterprises, they often prefer investments where a quick profit can be taken before the government can impose tax burdens, becoming in effect an unwelcome partner sharing the profits, but not the risk. Businesses with considerable fixed assets are often subject to heavy licenses, pressure to financially support the political party in power, extensive governmental control, and so on. Investors capable of making long term investments are therefore reluctant to undertake them; (3) there is a greater tendency for the establishment of service concerns rather than more productive enterprises such as manufacturing. Not only is potential productivity reduced when this is done, but growth becomes seriously unbalanced; (4) underdeveloped countries erect nationalistic barriers to importing capital on terms that would

be acceptable to investors.

Samuelson aptly stated the problem of capital shortages in underdeveloped countries when he said,

The fingers and brains of men in the underdeveloped countries are much like the fingers and brains of their more prosperous brethren; but men in advanced nations work with a plentiful supply of capital goods built up over the years. *[italics not in the original]* To pile up net capital formation requires . . . a sacrifice of current consumption. But there's the rub: underdeveloped countries are already too poor as to be near the minimum of subsistence; they feel that they cannot -- in fact, they do not -- save a very large share of their current national incomes.²³

The criterion of success in the development efforts of an economy may be stated as the rate of industrial absorption in excess of the rate of population growth. In order to make an empirical test of this model, Ranis and Fei compared the rate of population growth for the industrial labor force with the overall rate of population growth for Japan over a time series from 1888 to 1930.²⁴ The results of their study indicated that the labor force in the industrial sector had grown at a faster rate than population growth over a period of many years. They concluded that the subsistence sector no longer existed, thus permitting rapid economic development.

²³P. A. Samuelson, Economics An Introductory Analysis (New York: McGraw-Hill Book Co., 1964), p. 768.

²⁴G. Ranis and J. C. H. Fei, "Innovation, Capital Accumulation and Economic Development," American Economic Review, LIII (June, 1963), p. 631.

CHAPTER III

THE STUDY

The study, first, was an effort to learn what meaningful ~~relationships~~ could be established between economic variables and population variables using statistical data, ~~principally~~ obtained from United Nations publications. Secondly, probably the more important part of the study was concerned with comparing the rate of industrial absorption of the labor force to population growth for each country studied.

Basis of selection of countries. Countries in Latin America differ in many ways, with some being vastly large in geographical size, some quite small. The current state of economic development differs widely, the size of population, the ethnic backgrounds also vary radically.

The primary consideration in making selections was the availability of economic data. While population statistics are commonly available, many countries do not accumulate sufficient economic data to permit empirical studies.

Some effort was made to select a variety in terms of geographical size, population totals, and state

of economic development. Table I is given to indicate some of the characteristics of each country. It should be noted that the property common to each country is the rate of population increase, exceeding two percent per year in each case.

TABLE I
SELECTED CHARACTERISTICS OF COUNTRIES STUDIED

	Chile	Ecuador	Honduras	Paraguay
Geographical Area*	286.4	104.5	59.2	157.0
Average Annual Rate of Population Growth 1953-62**	2.2%	3.2%	3.0%	2.5%
Total Population 1962 (mid-year)	8,029	4,581	1,950	1,863
Per Capita Gross National Product 1962	422	188	194	173

*Source: National Geographic Society, National Geographic Atlas of the World (National Geographic Society, Washington, D. C., 1963). Given in thousands of square miles.

**Source: United Nations, Demographic Yearbook 1963 (United Nations, New York, 1964).

Source: Ibid. Given in thousands.

Source: United Nations, Yearbook of National Accounts 1963 (United Nations, New York, 1964).

Relationship between economic and demographic variables. The time period selected for this part of the study ran from 1953 to 1962 for these reasons: (1) the most current information available was desired in order to make the study as meaningful as possible. Figures for 1962 are the latest available; (2) adjustments for inflation would have been very difficult for a longer period; (3) the last decade has been one of extremely rapid population growth and the desire to test this influence on economic progress was paramount.

The first demographic variable investigated was total population. While it is recognized that the determination of an optimal population for a given country is impossible under the current state of economic art, the following tests were made in hopes of realizing some indication, however slight, of the present situation. Total population was correlated with gross national product, consumption, and gross domestic fixed capital formation data from each country.¹ A population density for land now devoted to agriculture, plus land unused but consid-

¹Computation for all correlations were made using a University of California at Los Angeles correlation program -- BINED 6 -- on a Control Data 1604 Computer located at the University of California at Los Angeles, California.

ered potentially productive, was computed for the countries under study. Several other countries throughout the world were included for comparison.

In order to study the effects of the population growth rate on per capita income, calculations were first made to determine the actual rate of growth.² Yearly per capita gross national product was also computed along with the yearly percentage change in per capita product. The yearly changes were averaged to obtain one growth rate for the ten year period. Modest changes in yearly population growth rates were then introduced through this same series of computations to demonstrate what per capita gross national product might have been, given lower birth rates.

To study changes in age composition, the percentage of population over fifteen years of age, but not yet sixty-five for the 1950 census as compared with like data from the 1960 census to see what shift, if any, in the number of productive persons had taken place. Like

²Rate of increase in population was computed using the following formula: $r = (\sqrt[t]{P_1/P_0} - 1) \times 100$, where t = the number of years between P_1 and P_0 ; P_0 is the population at the start of the period and P_1 is the population at the end of the period. r = rate of population growth. This is the formula used by the United Nations in making population calculations.

computations were made for other selected countries throughout the world to provide comparisons. Definition of productive persons as those fifteen years of age or older, but not over sixty-five, was made because United Nations data is arranged in this manner. Unfortunately, year to year data was not available to provide better trend indication.

Using the Lewis criterion of successful economic development efforts -- that of transferring labor from the relatively low productive agricultural sector to more productive employment in the capitalistic sector -- a study was made of Chile using University of Chicago data and also of Honduras employing United Nations data. (Data was not available for Ecuador or Paraguay.) United Nations data is not arranged to show the total number of industrially employed, but rather shows the number employed in the specific categories of mining, manufacturing, construction, and power production. These were added to obtain totals, then arranged as percentages of the total economically active population. Data from the University of Chicago was arranged to indicate the number employed in the same general categories listed above, also as percentages of the total economically active population.

CHAPTER IV

RESULTS AND CONCLUSIONS

Throughout this chapter the results obtained from the study of empirical data for the countries of Chile, Ecuador, Honduras, and Paraguay will be listed. Whenever possible, evaluations will then be made

Total population. Table II, on page 34, gives the results of correlations where the level of significance was .05 or less.¹ The majority of correlation results obtained had to be rejected because the level of significance was so high as to warrant no confidence in them. These spaces have been left blank in Table II.

For Chile, Ecuador, and Honduras, it appears that gross national product and consumption have been significantly related to population. Two facts should be noted: (1) Paraguay, for whom the level of significance on all correlations was so high as to warrant rejection had the lowest gross national product per capita (express in U. S. dollars) of the four countries; (2) Ecuador was the only country exhibiting a high correlation between population trends and capital formation trends. Whether a definite

¹Appendix A contains the correlation formula used as well as graphical plots of data for Honduras. The data used in the correlations for each country is also given.

TABLE II
CORRELATIONS BETWEEN DEMOGRAPHIC
AND ECONOMIC DATA

Variables Correlated	Chile	Ecuador	Honduras	Paraguay
Population on Gross National Product	.93	1.00	.97	
Population on Consumption	.94	.99	.91	
Population on Capital Formation		.93		
Yearly Popula- tion Growth on Capital Formation				
Yearly Popula- tion Growth on Gross National Product				

cause and effect relationship between demographic and economic variables can be established for the results seen seems doubtful, however.

Table III, on page 36, supplies the population density data of land used for agriculture, plus land presently unused but considered potentially productive. Although the population density for these countries is not as high as that in parts of Asia, it is high relative to many developed nations. Fast rates of population growth coupled with primary dependence on an agricultural economy indicates serious problems could be expected.

While the foregoing study was conducted to determine the influence of total population on economic variables, it appears that economic variables might themselves exert considerable influence not only on total population, but on other demographic variables as well if the matrix of variables with their complex inter-dependencies could be sorted out.

Rate of population growth. Tables IV, V, VI, and VII, on page 37 through 40, have been constructed to indicate the actual population growth rate for each country as well as the per capita gross national product per capita for each year during the period of the study. As

TABLE III

AGRICULTURAL LAND USED OR POTENTIALLY PRODUCTIVE
(Millions of Acres)

Country	In Use (arable plus pasture)	Unused but potentially productive	Total	Population per acre
Chile	31.1	0	31.1	.26
Ecuador	1.9	0	1.9	.97
Honduras	7.7	13.1	20.8	.59
Paraguay	3.8	0	3.8	.49
United States	1116.9	15.0	1131.9	.16
India	305.9	91.0	396.9	1.50
Japan	16.0	0	16.0	6.00
Mexico	271.8	14.8	286.6	.12

Sources: S. S. Szytarsky and S. S. Szytarsky, World Population and Production (New York: The Century Company, 1953), pp. 472-473; United Nations, Demographic Yearbook 1963 (United Nations, New York, 1964)

TABLE IV

EFFECTS OF LOWER POPULATION GROWTH RATES ON
PER CAPITA GROSS NATIONAL PRODUCT IN CHILE

Year	With Actual Growth Rate				With Constant 2% Growth				With Constant 1.75% Growth			
	Actual popula- tion*	Per Capita GNP**	Growth in Per Capita GNP	Adjusted Total popula- tion*	Per Capita GNP**	Growth in Per Capita GNP	Adjusted Total popula- tion*	Per Capita GNP**	Growth in Per Capita GNP	Adjusted Total popula- tion*	Per Capita GNP**	Growth in Per Capita GNP
1952	6,205	626	2.07%	6,295	626		6,295	626		6,295	626	
1953	6,437	635	2.39	6,420	639	2.07%	6,405	640	2.24%	6,405	640	2.24%
1954	6,597	652	4.15	6,545	657	2.82	6,517	655	2.34	6,517	655	2.34
1955	6,761	654	0.30	6,676	667	1.52	6,631	671	2.44	6,631	671	2.44
1956	6,944	601	-8.21	6,809	609	-9.52	6,747	614	-9.29	6,747	614	-9.29
1957	7,121	623	3.66	6,945	637	4.59	6,845	645	5.05	6,845	645	5.05
1958	7,298	610	-2.13	7,024	657	3.13	6,935	656	3.25	6,935	656	3.25
1959	7,447	633	3.77	7,225	648	-1.39	7,102	659	-1.01	7,102	659	-1.01
1960	7,637	609	-0.64	7,371	642	0	7,299	655	-0.61	7,299	655	-0.61
1961	7,825	643	2.22	7,519	658	3.09	7,427	676	3.21	7,427	676	3.21
1962	8,009	672	4.51	7,668	701	4.94	7,557	711	5.19	7,557	711	5.19
Average	638.5	0.46%			64.7	1.16%		661.8	1.33%			

* Figures given in millions.

** Figures given in Escudos.

TABLE V

EFFECT OF LOWER POPULATION GROWTH RATES ON
PER CAPITA GROSS NATIONAL PRODUCT IN ECUADOR

Year	With Actual Growth Rate			With Constant 2% Growth			With Constant 1.75% Growth		
	Actual Population*	Per Capita GNP**	Growth in Per Capita GNP	Adjusted Total Population*	Per Capita GNP	Growth in Per Capita GNP	Adjusted Total Population*	Per Capita GNP	Growth in Per Capita GNP
1952	3,350	2336		3,350	2336		3,350	2336	
1953	3,464	2376	1.71%	3,417	2409	3.12%	3,409	2414	3.33%
1954	3,567	2506	5.47%	3,485	2565	6.47%	3,467	2573	6.79%
1955	3,691	2483	-0.92%	3,555	2578	0.50%	3,526	2599	0.91%
1956	3,800	2485	0.08%	3,624	2553	0.97%	3,593	2596	0.50%
1957	3,929	2532	1.49%	3,699	2689	5.32%	3,651	2725	5.37%
1958	4,049	2531	0.03%	3,773	2716	1.00%	3,715	2758	1.21%
1959	4,191	2565	1.34%	3,848	2787	2.61%	3,790	2837	2.86%
1960	4,317	2637	2.80%	3,925	2900	4.05%	3,846	2960	4.33%
1961	4,455	2550	-3.41%	4,004	2917	0.59%	3,913	2984	0.91%
1962	4,581	2641	3.56%	4,084	2962	1.54%	3,981	3039	1.84%
Average	2764.2	1.26%		2941.2	2.52%		3081.6	2.80%	

* Figures given in millions.

** Figures given in Sucres.

TABLE VI

EFFECTS OF LOWER POPULATION GROWTH RATES ON PER
CAPITA GROSS NATIONAL PRODUCT IN HONDURAS

Year	With Actual Growth Rate			With Constant 2% Growth			With Constant 1.75% Growth		
	Actual Popula- tion*	Per Capita GNP**	Growth in Per Capita GNP	Adjusted Total Popula- tion	Per Capita GNP**	Growth in Per Capita GNP	Adjusted Total Popula- tion	Per Capita GNP**	Growth in Per Capita GNP
1952	1.452	300		1.452	300		1.452	300	
1953	1.495	310	3.33%	1.481	313	4.33%	1.477	314	4.67%
1954	1.540	282	-9.92	1.511	288	-8.68	1.503	289	-8.65
1955	1.586	284	0.70	1.541	293	1.74	1.529	295	2.72
1956	1.633	302	6.33	1.572	313	6.38	1.566	317	7.46
1957	1.682	253	-19.36	1.603	328	4.79	1.583	332	4.75
1958	1.733	311	12.29	1.635	329	0.30	1.611	334	0.60
1959	1.785	314	0.96	1.668	336	2.22	1.639	342	2.39
1960	1.838	310	-1.29	1.701	335	-0.30	1.668	342	0
1961	1.893	312	0.64	1.735	345	2.99	1.697	348	1.75
1962	1.950	321	2.88	1.770	354	2.61	1.726	363	4.31
Average	299.9	0.34%		323.4	1.68%		327.6	2.01%	

* Figures given in millions.

** Figures given in Lempires.

TABLE VII

EFFECTS OF LOWER POPULATION GROWTH RATES ON PER
CAPITA GROSS NATIONAL PRODUCT IN PARAGUAY

Year	With Actual Growth Rate			With Constant 2% Growth			With Constant 1.75% Growth		
	Actual Popula- tion*	Per Capita GNP**	Growth in Per Capita GNP	Adjusted Total Popula- tion*	Per Capita GNP**	Growth in Per Capita GNP	Adjusted Total Popula- tion*	Per Capita GNP**	Growth in Per Capita GNP
1952	1.462	1025		1.462	1025		1.462	1025	
1953	1.496	1016	-0.88%	1.491	1019	-0.59%	1.488	1021	-0.39
1954	1.530	1010	-0.59	1.521	1016	-0.30	1.514	1020	0
1955	1.565	1067	5.64	1.551	1077	6.00	1.540	1085	6.27
1956	1.613	927	-9.77	1.582	992	-8.57	1.567	1002	-8.28
1957	1.648	986	1.44	1.614	1007	1.51	1.594	1020	1.80
1958	1.687	995	0.91	1.646	1020	1.29	1.622	1035	2.47
1959	1.728	868	-14.63	1.679	894	-14.09	1.650	910	-13.74
1960	1.768	855	-1.52	1.713	883	-1.26	1.679	900	-1.11
1961	1.812	855	0	1.747	886	0.34	1.708	906	0.67
1962	1.863	848	-0.82	1.782	887	0.11	1.738	909	0.33
Average		947.2	-1.82%		968.1	-1.56%		1083.4	-1.30%

* Figures given in millions.

** Figures given in Guaranies.

observed in Chapter III, population in each of these countries is considered to be growing extremely rapidly with rates in excess of three percent for Ecuador, and in excess of two percent per year for each of the others.² In order to demonstrate the effects of a lower rate of population growth on per capita gross national product, calculations were made for each country using a constant two percent growth and again using a constant one and three-quarters percent growth rate. These results are also given in Tables IV, V, VI, and VII. The advantages of reduced population growth rate can probably best be seen in the example of Ecuador. By reducing population growth rate from an average 3.2 percent to a constant two percent, average per capita gross national product increased from 2764.2 to 2941.2 Sucres, or an increase of 6.4 percent.³ Similar increases exist for the other countries. Coale and Hoover have estimated that a fifty percent linear reduction for three decades would provide an income thirty-eight to fifty percent higher than would occur with a

²See Table I, page 29.

³The calculations are correct if the commonly made assumption is accepted that decrease in population growth rates does not negatively affect gross national product. It should also be noted that this hypothesis is applicable only to underdeveloped countries. The implications of population trends in highly industrialized countries are quite different.

sustained growth rate; in fifty years, they estimate, income would double.⁴

It seems clear that with lower growth rates in population, non-productive investments which must be made to ~~provide~~ public facilities to meet the demands of an expanding population could be devoted to productive capitalization and thus raise per capita income even higher. This in turn would probably occasion higher rates of saving and investment.

Of course with a lower rate of population growth fewer dependent, non-productive persons would burden the economy, hence reduction in consumption to the benefit of savings would be realized.

Composition of population. Population by age composition is important in a country as it influences the ratio of dependent persons to productive persons. Hence, study was made of this ratio for each of the four countries. The percentages of each population fifteen years or older, but less than sixty-five was computed for the 1950 census and again for the 1960 census to indicate the trend in each country. As seen in Table VIII, page 43, the ratio has changed adversely

⁴Coale and Hoover, op. cit., p. 334.

TABLE VIII

NON-PRODUCTIVE POPULATION RATIOS
(In millions)

Country	Total 1950 Population	No. Under 14 plus Over 64	Total 1960 Population	No. Under 14 plus Over 64	1950 Ratio	1960 Ratio
Chile ^d	5.933	2.209	7.375	2.934	37.9	40.0
Ecuador ^d	3.202	1.369	4.515	2.037	42.7	45.1
Honduras ^e	1.358	.556	1.866	.897	40.6	48.0
Paraguay	1.328	.581	1.768	.843	43.7	46.3
United States	150.697	40.483	179.323	55.786	26.8	31.1
India ^{##}	356.799	133.622	438.271	180.070	37.4	41.1
Japan	83.199	31.427	93.347	28.024	37.7	30.0

Source: United Nations, Demographic Yearbook (New York: United Nations)^d 1952 vice 1950 census data given.^e 1962 vice 1960 census data given.^f 1961 vice 1950 census data given.^g 1951 vice 1950 census data given.

for each of the four countries. The ratio of dependent to productive persons in the Latin American countries shown is substantially higher in some cases than Asian countries and much higher than the ratio in the United States, with no prospects for improvement as long as the rapid rates of population growth continue. It should be noted that the statistics hide the fact that, because many members of the labor force in the United States (and other industrially advanced nations) do not actually enter the labor force until after they are twenty years old, the ratios are not as adverse as they appear on the surface.

Lewis developmental model. Assuming the Lewis developmental model to be correct, (an economy in order to progress must shift workers from the relatively unproductive agricultural sector to the industrial sector where each worker has some capital to help him increase his output) study was made of the percentage increases of labor in the non-agricultural sector.

The results for Chile, as seen in Table IX, on page 45, indicate a lack of progress toward getting the industrial worker's wage based upon his marginal productivity.

TABLE IX

PERCENTAGE OF TOTAL ECONOMICALLY ACTIVE POPULATION
ENGAGED IN NON-AGRICULTURAL ACTIVITY IN CHILE

Year	Percentage
1907	62.3
1920	63.8
1930	65.7
1952	67.8
1957	67.9

Source: M. A. Ballesteros and T. E. Davis, "The Growth of Output and Employment in Basic Sectors of the Chilean Economy, 1907-1957," Economic Development and Cultural Change, XI (January, 1963), p. 176.

TABLE X

PERCENTAGE OF TOTAL ECONOMICALLY ACTIVE POPULATION
ENGAGED IN NON-AGRICULTURAL ACTIVITY IN HONDURAS

Year	Percentage
1940	48.6
1950	52.9
1953	51.6
1956	50.1
1960	51.7

Source: United Nations, Demographic Yearbook (United Nations, New York)

Summary of conclusions One of the chief difficulties in the study of Latin America is the lack of reliable data about economic performance, and to a lesser extent, lack of sufficient population data. While the tools used in economic analysis are often not as good as those desired, their usefulness here is impaired by lack of reliable data.

It appears that no valid conclusion can be reached as to whether the four countries have yet passed or even reached their optimum total population. Moreover, it is felt that certain dangers lie in the employment of comparative statics which optimum population theory requires. In this era of rapid change, technical or other innovations may make today's theoretically optimal population not optimal tomorrow, or the reverse, and the further into the future theories project, the greater the risk of error.

For the reasons indicated above, it is felt that attempts to determine relationships between demographic and economic variables through correlation analysis must proceed carefully if acceptable results are to be achieved. It is quite possible that relationships might be bi-directional, that economic variables will influence demographic variables at the same time demographic vari-

ables are exerting influences, and it may at times be difficult to establish generally acceptable interpretation of results through economic theory.

The rate of population growth in much of Latin America is one which if continued will double the population every thirty years. This fact places great strain on the economic systems of these countries as they struggle to improve or even maintain their per capita incomes, which are already so low as to result in widespread poverty.

If the assumption is accepted that negative effects on gross national product do not occur with reductions in population growth rates, it has been seen that modest reductions in growth rate can directly affect per capita income substantially.

High rates of population growth also affect the ~~and composition~~ of the population. Greater numbers are added to the body of unproductive workers which adversely affects the ratio of productive to non-productive persons. In this respect, the ratios in Latin America are trending adversely at present while the prospect of improvement appears hopeless with the continuing high rate of births.

The results seen from application of the Lewis model indicate lack of progress in moving the labor force from agriculture to more productive employment.

A. BOOKS

Coale, Ansley J. and Edgar M. Hoover. Population Growth and Economic Development in Low Income Countries. Princeton, New Jersey: Princeton University Press, 1958.

Enke, Stephen. Economics for Development. Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1954.

Hauser, Philip M. and Otis Dudley Duncan. The Study of Population An Inventory and Appraisal. Chicago: The University of Chicago Press, 1959.

Leibenstein, Harvey. Economic Backwardness and Economic Growth. New York: John Wiley and Sons, Inc., 1957.

Malthus, Thomas Robert. On Population. Edited by Gertrude Himmelfarb. New York: The Modern Library, 1960.

Samuelson, Paul J. Economics An Introductory Analysis. New York: McGraw-Hill Book Co., 1964.

United Nations. Demographic Yearbook 1963. New York: United Nations, 1964.

_____. The Determinants and Consequences of Population Trends: Population Studies No. 17. New York: United Nations, 1963.

_____. Human Resources of Central America, Panama and Mexico, 1950-1980, in Relation to Some Aspects of Economic Development. New York: United Nations, 1960.

_____. Yearbook of National Account Statistics, 1963. New York: United Nations, 1964.

Woytinsky, W. S. and E. S. Woytinsky. World Population and Production. New York: The Twentieth Century Fund, 1953.

B. PERIODICALS

- Ballesteros, M. A. and T. E. Davis. "The Growth of Output and Employment in Basic Sectors of the Chilean Economy, 1907-1957," Economic Development and Cultural Change, XI (January, 1963), pp. 152-176.
- Dorfman, Robert. "Economic Implications of An Aging Population," American Economic Review, XLIV No. 2 (May, 1954), pp. 634-679.
- "Facts and Figures," Americas, XVI (July, 1964), p. 46.
- Fukuoka, Masao. "Full Employment and Constant Coefficients of Production," Quarterly Journal of Economics, LXIX, pp. 23-44.
- Lewis, W. A. "Development With Unlimited Supplies of Labour," The Manchester School, 1954.
- Paauw, Douglas S. "Some Frontiers of Latin American Research In Economic Development," Economic Development and Cultural Change, IX (January, 1961), pp. 180-190.
- Ranis, Gustav. "The Population Problem," American Economic Review, LIII No. 2 (May, 1963), pp. 622-626.
- Ranis, Gustav and J. C. H. Fei. "A Theory of Economic Development," American Economic Review, LI No. 2 (May, 1961), pp. 533-565.
- _____. "Innovation, Capital Accumulation And Economic Development," American Economic Review, LIII (June 1963), pp. 626-633.
- Spengler, J. J. "The Population Obstacle to Human Betterment," American Economic Review, XLI No. 2 (May, 1951), pp. 343-354.

APPENDIX A
CORRELATION APPENDIX

As stated in footnote 1, on page 30, all correlations were made using a University of California at Los Angeles correlation program -- BIMED 6 -- on a Control Data 1604 Computer. The mathematical formula used in this program is given as:

$$r_{ij} = \frac{\sum (x_i - \bar{x}_i) (x_j - \bar{x}_j)}{\sqrt{\sum (x_i - \bar{x}_i)^2} \sqrt{\sum (x_j - \bar{x}_j)^2}}$$

where r_{ij} is the correlation coefficient.

Tests of significance were then made using t values (also supplied by the same program) which had been computed using "Student's" t distribution. Levels of significance were determined by entering a table of Percentile Values of "Student's" t Distribution.¹

Figures 4 and 5, on pages 51, and 52, are plots of the data correlated for the country of Honduras.

Tables XI through XIV, on pages 53 to 56, contain the basic data that was used for correlation.

¹M. R. Spiegel, Schaum's Outline of Theory and Problems of Statistics (New York: Schaum Publishing Co., 1961), p. 344.

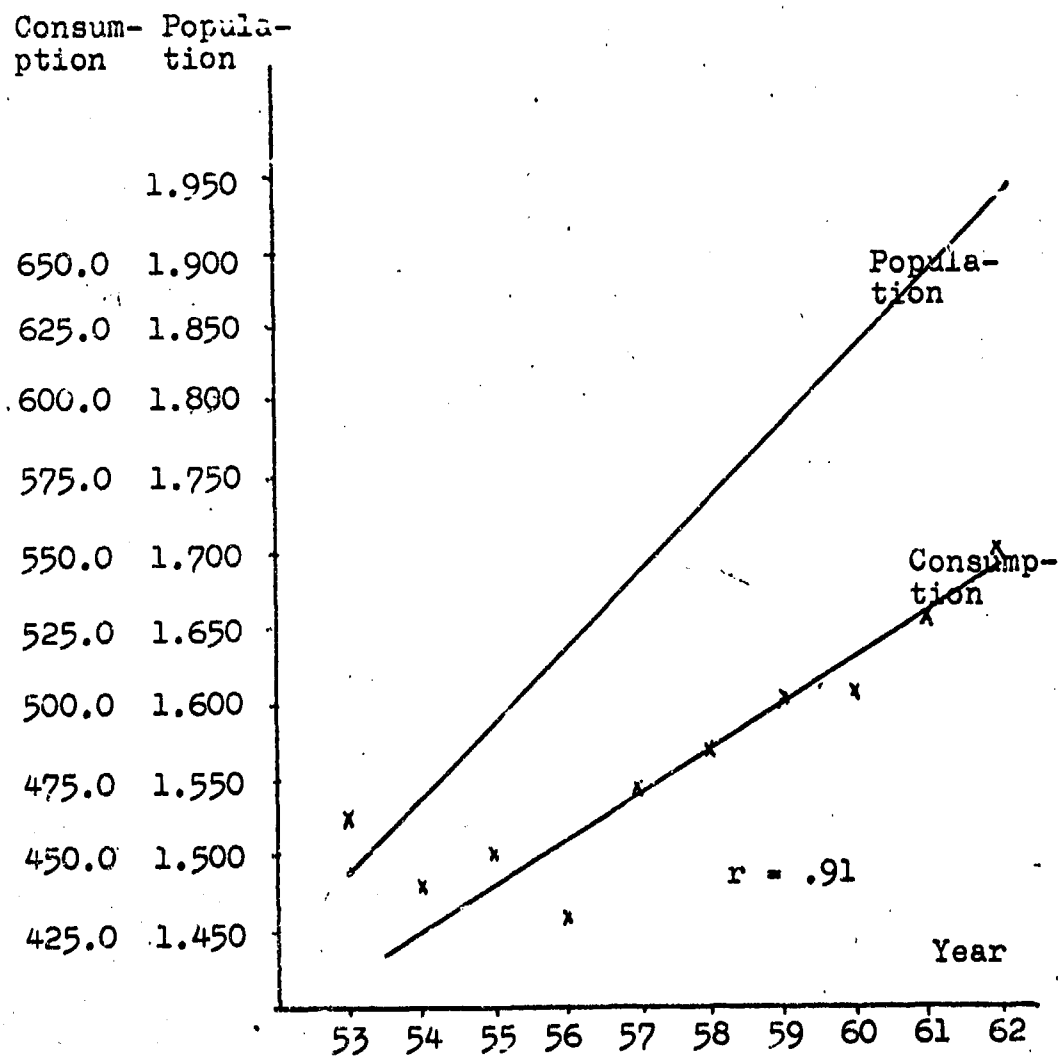


FIGURE 5
PLOT OF POPULATION AND CONSUMPTION FOR HONDURAS

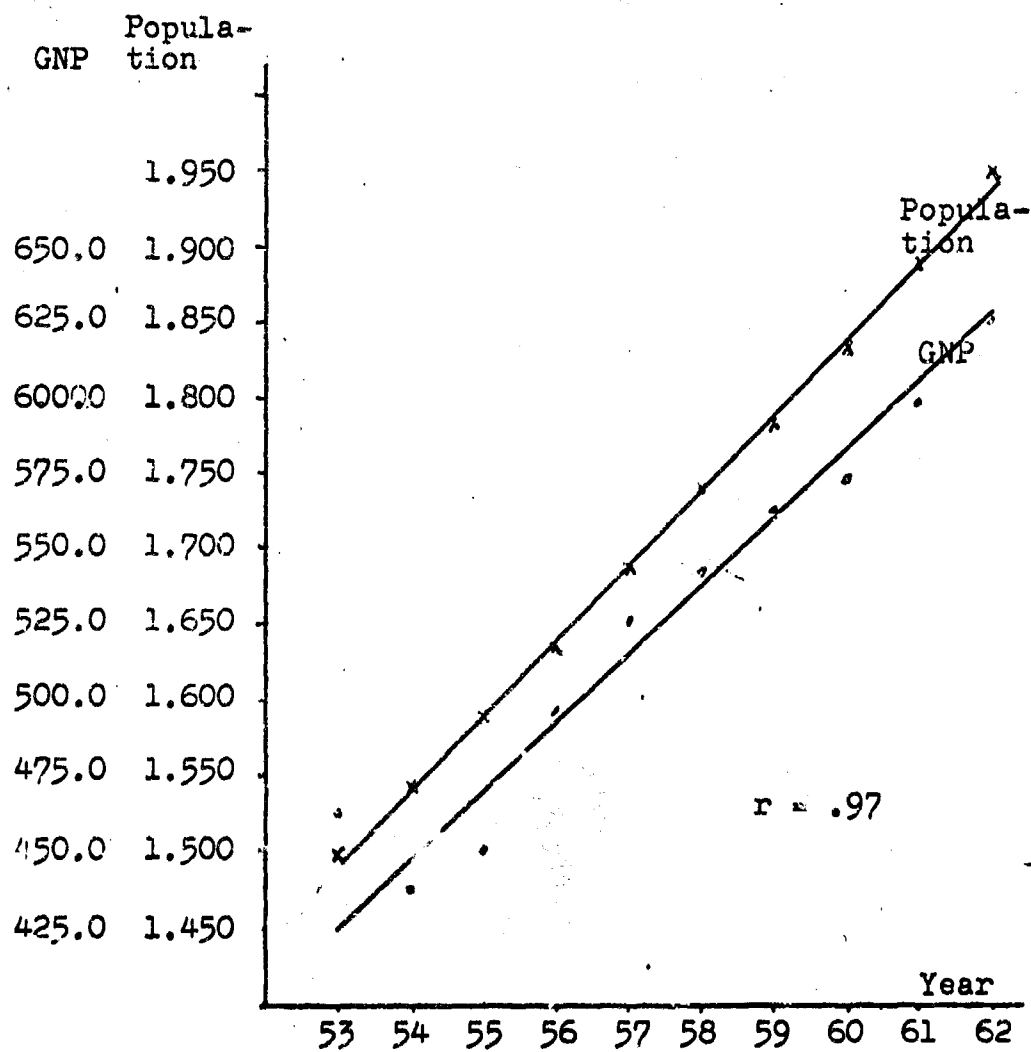


FIGURE 4

PLOT OF POPULATION AND GNP FOR HONDURAS

TABLE XI

SELECTED DATA FOR CHILE

Year	Expenditures in GNP*	Government and Private* Consumption	Gross Domestic Fixed Capital Formation*	Population**	Percentage Population Growth
1952	3944.0	3341.2		6.295	1.850
1953	4103.1	3535.5	426.8	6.437	2.255
1954	4305.1	3891.3	420.2	6.597	2.485
1955	4452.6	3913.0	485.6	6.761	2.485
1956	4147.1	3675.4	423.9	6.944	2.706
1957	4429.9	4049.5	472.8	7.121	2.548
1958	4656.6	4181.5	436.2	7.298	2.485
1959	4686.8	4136.2	461.4	7.447	2.457
1960	4781.0	4342.0	405.0	7.637	2.561
1961	5023.0	4422.0	430.1	7.825	2.473
1962	5380.0	4577.0	451.7	8.009	2.356

* Source: United Nations, Yearbook of National Account Statistics 1960, 1963.
In million Escudos adjusted to 1960 market price.

** Source: United Nations, Demographic Yearbook 1963. Midyear estimate given.

TABLE XII

SELECTED DATA FOR ECUADOR

Year	Expenditures on GNP*	Government and Private Consumption*	Gross Domestic Fixed Capital Formation*	Population**	Percentage Population Growth
1952	7944	6939	753	3,350	3.402
1953	8232	7283	910	3,464	2.973
1954	8940	7650	1214	3,567	3.467
1955	9165	7870	1312	3,691	2.953
1956	9444	8226	1352	3,800	3.394
1957	9949	8527	1335	3,929	3.054
1958	10249	8838	1289	4,049	3.260
1959	10725	9133	1473	4,181	3.252
1960	11385	9938	1547	4,317	3.196
1961	11680	10245	1612	4,455	2.828
1962	12099	10558	1753	4,531	

* Source: United Nations, Yearbook of National Account Statistics 1960, 1963.
In million Sucre adjusted to 1950 market price..

**Source: United Nations, Demographic Yearbook 1963. Midyear population estimate.

TABLE XIII
SELECTED DATA FOR HONDURAS

Year	Expenditures on GNP*	Government and Private Consumption*	Gross Domestic Fixed Capital Formation*	Population**	Percentage Population Growth
1952	435.9	435.9	73.3	1.452	
1953	464.3	464.3	81.5	1.495	2.961
1954	434.8	434.8	60.1	1.540	3.010
1955	451.9	451.9	65.4	1.586	2.987
1956	493.4	430.8	66.5	1.633	2.963
1957	526.3	473.9	73.6	1.682	3.000
1958	539.1	483.1	66.3	1.733	3.032
1959	560.8	492.7	63.8	1.785	3.000
1960	570.6	506.8	67.9	1.838	2.969
1961	591.1	529.7	62.6	1.893	2.992
1962	626.7	551.6	81.2	1.950	3.011

* Source: United Nations, Yearbook of National Account Statistics 1960, 1963.

** In million Lempias adjusted to 1948 market price.

** Source: United Nations, Demographic Yearbook 1963. Midyear population estimate.

TABLE XIV
SELECTED DATA FOR PARAGUAY

Year	Expenditures on GNP*	Government and Private Consumption**	Gross Domestic Fixed Capital Formation**	Population**	Percentage Population Growth
1952	15000	1.462	2.325
1953	15200	1.496	2.272
1954	15455	14360	1253	1.530	2.287
1955	16704	16020	1301	1.565	3.067
1956	15694	14029	1266	1.613	2.169
1957	16252	16070	1472	1.648	2.366
1958	16787	16028	2192	1.687	2.430
1959	15015	14412	1190	1.728	2.314
1960	15118	14732	1457	1.768	2.488
1961	15497	14340	1272	1.812	2.814
1962	15801	14635	1291	1.863	

* Source: United Nations, Yearbook of National Account Statistics 1960, 1963.

in million Guaranies adjusted to 1956 market price.

** Source: United Nations, Demographic Yearbook 1963. Midyear population estimate.